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Perspectives on the Global Impact and Effectiveness of Covid-19 Vaccines against Emerging SARS-Cov-2 variant Omicron

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Opinion
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Abstract

The new Omicron (B.1.1.529) variant of Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) was reported on November 2021 in South Africa and classified as a variant of concern by WHO. It spread globally in a very short span and became a predominant variant in several countries. The emerging Omicron variant is a highly transformed virus with more than 50 mutations, and the majority were found in Spike (S) protein that interacts with human cells. This Covid-19 outbreak resulted in more than 5 million deaths with an ongoing hike in morbidity and mortality, leaving economic recession worldwide. Currently, several Covid-19 vaccines have been approved that mainly were rely on S-protein. As the SARS-CoV-2 virus evolves to get fit and escape host immunity, the effectiveness of existing Covid-19 vaccines against the new variants needs to be addressed. Here, we have presented various perspectives on the global impact of new variant Omicron and ongoing vaccine developments to fight against dangerous future variants with high transmissibility and evade host neutralizing antibodies.

Keywords: SARS-CoV-2; Coronavirus Disease; Respiratory Syndrome; Omicron; Vaccines

Introduction

Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) is a positive-sense single-stranded RNA virus that causes a contagious Coronavirus disease 2019 (COVID-19). The first SARS-CoV-2 infection was reported in Wuhan, China, in December 2019 and then spread worldwide to an ongoing pandemic. As of 24th December 2021, more than 277 million confirmed cases of COVID-19 with greater than 5 million deaths were reported to the World Health Organization (WHO) (https://covid19.who.int/). Though most countries have given emergency use authorizations for several Covid-19 vaccines, the slow pace of vaccination and genetic transformation of SARS-CoV-2 virus transmission among unvaccinated people pose a risk of dangerous variants in the near future. The virus has already undergone several mutations that resulted in highly transmissible variants and evaded the host immune system. Here, we have indicated perspectives on the impact of emerging Omicron variant globally and discussed the effectiveness of current Covid-19

vaccines against the variants.

Variants of SARS-CoV-2

Generally, the RNA viruses with their genetic material packed inside a protein shell are prone to high mutation rates, at least a million times higher than their hosts do. Moreover, the lack of proofreading mechanisms in replication machinery contributes to the higher genetic diversity of RNA viruses and confers them to adapt to changes in their environment. These high rate mutations in the RNA viruses usually correlate with their evolution, increased virulence, and gain of traits beneficial for virus existence. However, higher mutation rates result in deleterious effects and may lead to the extinction of viruses [1]. One such RNA virus is SARS-CoV-2, and it is not exceptional for mutations. Since the beginning of the Covid-19 pandemic, several SARS-CoV-2 variants with different mutations emerged and spread globally. Analysis of early variants of SARS-CoV-2 genomic sequences revealed that SARS-CoV-2 RNA-dependent RNA polymerase (RdRp) would be a mutational hotspot for drug-resistant phenotypes [2]. In addition, the variants with D614G mutation in spike protein raised concern and spread across the world within a few months. In a short span of time, SARS-CoV-2 variants with the highest rate of transmissibility and infection rates raised concern across the world [3]. Among different SARS-CoV-2 variants (Alpha/Beta/Gamma/Epsilon/Eta/Iota/Kappa/Mu/Zeta), the highly fit and immune-evasive Delta variant (B.1.617.2) had a major impact on the ongoing pandemic due to its higher infectious nature and transmissibility [4]. Delta variant was first identified in India in December 2020. Later, it spread to over 90 countries and became a dominant one until a new variant Omicron was evolved.

Global Impact of Omicron-A new variant of SARS-CoV-2

A new SARS-CoV-2 variant Omicron (B.1.1.529) was reported on 24th November 2021 by South Africa to WHO. On 30th November 2021, the U.S. government SARS-CoV-2 Interagency Group (SIG) classified Omicron as a Variant of Concern (VOC). This Omicron spread across the globe in a short span and became the predominant variant in most countries, including the United Kingdom and the United States. This emerging variant was found to be highly transformed with more than 50 mutations. The majority of mutations were found combinedly in spike (S)-protein that coronavirus uses to attach to human cells, with 30 amino acid substitutions, three small deletions, and one small insertion. Some of the mutations in S-protein were found earlier in other SARS-CoV-2 variants such as Alpha and Delta, which are associated with high infectivity and the ability to escape neutralizing antibodies in the host. The current rate of Covid-19 infections indicates clearly that the Omicron variant is highly transmissible. However, we have to wait for some more time to assess the severity of the Covid-19 and deaths caused by the Omicron variant. The Omicron variant emerged as a dominant strain overtaking the Delta variant quickly and posing a potential risk for unvaccinated people specifically. Though most Covid-19 vaccine manufacturers claim that the booster vaccinations might offer protection against this highly infectious Omicron variant, the currently available data is insufficient to approve those claims.

Effectiveness of Covid-19 vaccines against Omicron variant:

Typically, the vaccines will be evaluated and approved for use based on both the safety and efficacy. The approaches for vaccine design could use either whole virus, viral parts to trigger an immune response, or viral genetic material (DNA or RNA). The Covid-19 vaccines were developed by several manufacturers at a rapid pace and successfully launched into the market after emergency use authorization (EUA) by WHO within a year of the pandemic starting. The WHO Emergency Use Listing (EUL) process determines whether the vaccine can be recommended for use based on all the safety and efficacy data available, suitability in low- and middle-income countries. Different Covid-19 vaccines that got EUL by WHO for use are listed in Table-1. In addition, some vaccines got domestic emergency use authorization in accordance with their national regulations and were not subject to WHO approval. Till now, a total of 9 billion covid-19 vaccine doses have been administered globally, as reported to WHO (Table 1).

Most of the Covid-19 vaccines rely on SARS-CoV2 spike (S) protein for eliciting neutralizing antibodies. Still, the way antigen is presented to the host immune system considerably varies between different types of vaccines and thus their reactogenicity [5]. It was recently reported that previous SARS-CoV-2 infection combined with Covid-19 vaccination drove the production of enhanced antibodies for better potency. So, it was suggested that booster vaccinations might help better efficacy against S-variants [6]. It is evident that the current vaccines could protect the host from new variants, and the research is still ongoing to assess the effectiveness of vaccines and Covid-19 severity against the new variant Omicron. Due to the slow pace of vaccinations across the globe, everyone must take safety precautions to protect and stop the spread of the highly contagious new variant Omicron. Before the development of Covid-19 vaccines, several drugs were repurposed and found effective for disease management to a greater extent. However, the effectiveness of these drugs against new variants needs to be addressed. As the virus is continuing to evolve and the risk of dangerous variants, it was proposed by Hussain A et al.

for testing the efficacy of therapeutic monoclonal antibodies (mAbs) targeting S-protein RBD for rapid and sensitive advancement to control the pandemic [7]. Since the current vaccines pose difficulty to low-income countries due to the requirement of cold storage and complicated distribution, very recently, the protein-based SARS-CoV-2 vaccine has been developed and tested for *in vivo* efficacy. These protein-based vaccines utilize S-protein RBD conjugated to a nanobody that specifically targets antigen-presenting cells and is found to elicit immunity against SARS-CoV-2 and its variants [8]. Based on the various mutations reported in SARS-CoV-2 variants, it is evident that natural selection might be benefitting the virus to improve [9]. Lastly, it is reasonable to develop new vaccines that will present different antigens at once, and conserved antigens with a low mutation rate would overcome the ongoing pandemic.

S.No.	Name of Vaccine	Manufacturer	Type	Date obtained EUL
1	BNT162b2; Comirnaty	BioNTech-Pfizer (Germany, USA)	mRNA	31st December 2020
2	AZD1222; Vaxzevria; COVISHIELD; ChAdOx1-S	University of Oxford-AstraZeneca (UK, Sweden)	Adenovector	16th February 2021
3	Ad26.COV2.S, COVID-19 Vaccine Janssen	Janssen-Johnson & Johnson (NL/USA)	Adenovector	12th March 2021
4	mRNA-1273, COVID-19 Vaccine Moderna	Moderna-NIAID (USA)	mRNA	30th April 2021
5	BBIBP-CorV, Sinopharm COVID-19 vaccine	Sinopharm, Beijing Institute of Biological Products Co. (China)	Inactivated whole virus	7th May 2021
6	CoronaVac	Sinovac (China)	Inactivated whole virus	1st June 2021
7	COVAXIN, BBV152	Bharat Biotech (India)	Inactivated whole virus	3rd November 2021

Table 1: List of different Covid-19 vaccines validated for use by WHO (given EUL).

Conclusion

The current scenario with highly evolved Omicron variant and experience with older variants indicate that the SARS-CoV-2 virus continues to evolve by mutations. So, the resulting future variants could be more harmful if the virus finds potential mechanisms to escape the host immune system and currently available vaccines. As the current covid-19 vaccines were found effective to a greater extent against the variants upon booster doses, it is advised that vaccination would be the best way to stop new infections, transmission, and thus virus selection. The research is still continuing to know how much these vaccines protect against disease and transmission of SARS-CoV-2. Finally, the risk of compromised efficacy of current Covid-19 vaccines against emerging SARS-CoV-2 variants further warrants us to continue safety measures for controlling the new infections.

Conflicts of Interest

None

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